Federal Aviation Administration

AACE

Airworthiness Assurance Center of Excellence

Airworthiness Assurance Center of Excellence

Jim White
AACE Program Manager

November 5, 2003

What Is AACE?

Federal Aviation Administration
AACE
Airworthiness Assurance Center of Excellence

AIRWORTHINESS ASSURANCE

AIRWORTHY: *FIT FOR OPERATION IN THE AIR*

ASSURANCE: *PLEDGE OR GUARANTEE*

"KEEP THE GOOD PLANES IN THE AIR AND THE BAD PLANES ON THE GROUND"

Role of AACE

PROVIDE A LINK BETWEEN THE PEOPLE WHO BUILD, FLY AND MAINTAIN AIRCRAFT

AND

THE PEOPLE WHO WRITE AND ENFORCE THE REGULATIONS.

CONNECT RULE MAKERS

TO THE TOOL MAKERS.

Partners

- GOVERNMENT
  - CONGRESS
  - FAA
    - REGULATION AND CERTIFICATION
    - AVIATION RESEARCH
      - AIRCRAFT AND AIRPORT SAFETY R&D
- ACADEMIA
- INDUSTRY

Academia

29 Member Universities

- Arizona State University
- Baylor University
- Carnegie Mellon University
- Embry-Riddle Aeronautical Univ.
- Florida International University
- Iowa State University
- John Hopkins University
- Lehigh University
- Mississippi State University
- NJ Institute of Technology
- North Carolina A&T State Univ.
- Northwestern University
- Ohio University
- Pennsylvania State University
- Purdue University
- Rutgers University
- The Ohio State University
- The University of Arizona
- Tuskegee University
- UC-Berkeley
- UC-Los Angeles
- UC-Santa Barbara
- University of Dayton
- University of Maryland
- University of Missouri-Columbia
- University of North Dakota
- University of Utah
- Wayne State University
- Wichita State University
- *Sandia National Laboratories*

AACE Members

Geographic locations

Federal Aviation Administration

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Consortia and Laboratories

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CENTER FOR AVIATION SYSTEMS RELIABILITY (**CASR**)

ENGINE TITANIUM CONSORTIUM (**ETC**)

CENTER FOR AVIATION RESEARCH AND AEROSPACE (**CARAT**)

AGING AIRCRAFT NONDESTRUCTIVE INSPECTION VALIDATION CENTER (**AANC**)

NATIONAL INSTITUTE FOR AVIATION RESEARCH (**NIAR**)

Center For Aviation Systems Reliability

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- IOWA STATE UNIVERSITY
- NORTHWESTERN UNIVERSITY
- MICHIGAN STATE UNIVERSITY
- WAYNE STATE UNIVERSITY
- NORTH CAROLINA A&T

- BOEING
- ROLLS ROYCE
- PRATT & WHITNEY
- GENERAL ELECTRIC
- UNITED AIRLINES
- DELTA AIRLINES
- D&W
- SHERWIN
- CESSNA
- NORTHWEST AIRLINES
- HOWMET
- HITCHCOCK
- NORTHRUP GRUMMAN
- HONEYWELL
- PANAMETRICS FOERSTER
- AMERICAN AIRLINES
- CACRC
- IOWA ARMY NATIONAL GUARD

Engine Titanium Consortium

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- IOWA STATE UNIVERSITY
- GENERAL ELECTRIC
- PRATT & WHITNEY
- HONEYWELL

National Institute For Aviation Research

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- WICHITA STATE UNIVERSITY
- THE BOEING COMPANY
- BOMBARDIER AEROSPACE – LEARJET
- CESSNA AIRCRAFT COMPANY
- RAYTHEON AIRCRAFT

AACE History

Federal Aviation Administration
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- Phase I

SEPTEMBER 1997 – NOVEMBER 2000

14 UNIVERSITIES

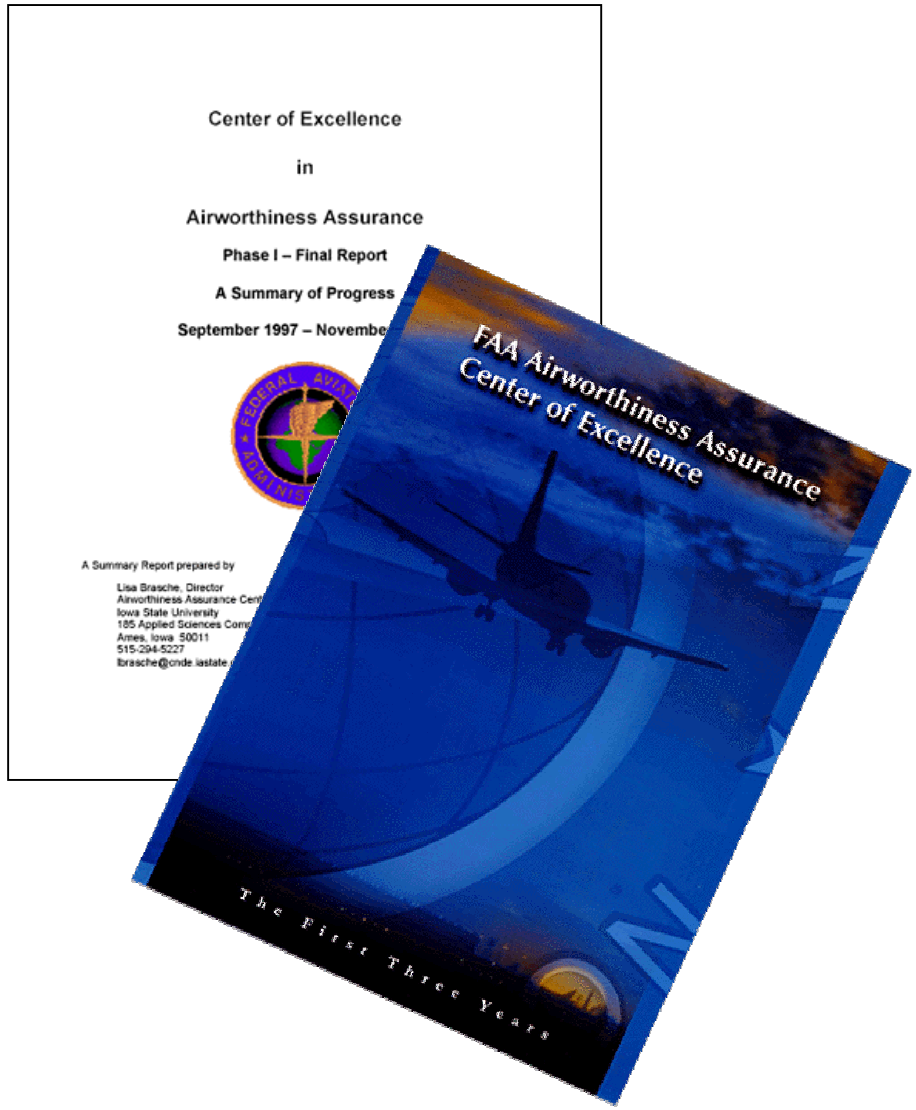
OVER 50 INDUSTRY PARTNERS

SUPPORTED NEARLY 100 STUDENTS

GENERATED OVER 150 PUBLICATIONS

Phase I Results

- Phase I report
- Generated Patents, Licensing and Commercialization
- Completed Field and Beta tests of various NDI techniques
- Available on-line at http://www.coe.faa.gov/aace/news.html



AACE Phase II

- Phase II (DECEMBER 2000 - PRESENT)
  - 29 UNIVERSITY MEMBERS and SANDIA
  - ADMINISTERED AND MANAGED BY FAA
    - SEPARATE COOPERATIVE AGREEMENTS
    - INDIVIDUAL GRANTS/ CONTRACTS TO MEMBERS.

Program Areas

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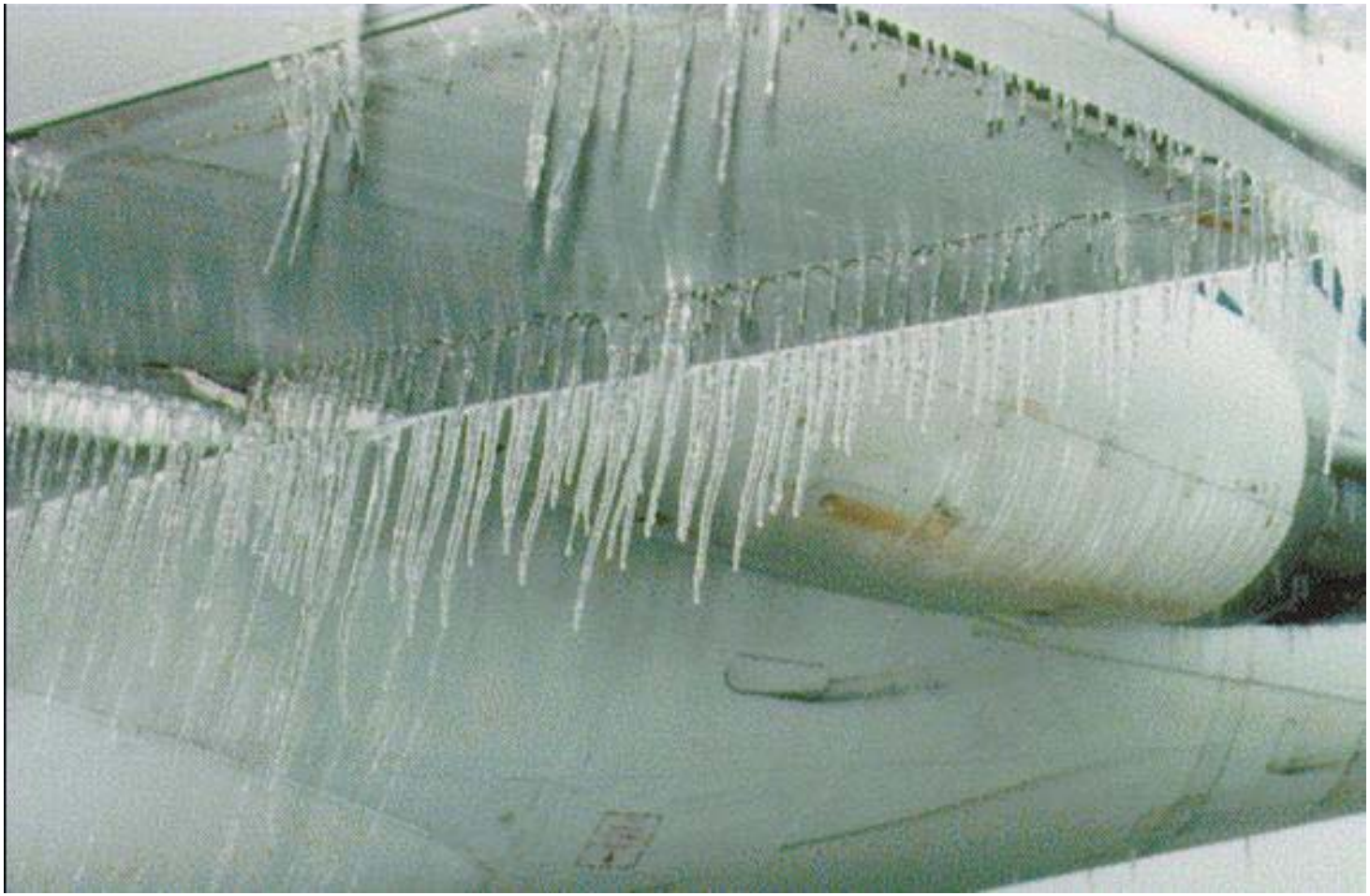
AGING AIRCRAFT

- ATMOSPHERIC HAZARDS
- AVIATION SAFETY RISK ANALYSIS
- CATASTROPHIC FAILURE PREVENTION
- CRASHWORTHINESS
- INSPECTION, MAINTENANCE & REPAIR
- PROPULSION AND FUELS
- SOFTWARE AND DIGITAL SYSTEM DISPLAY
- STRUCTURAL INTEGRITY AND FLIGHT LOADS

ADVANCED MATERIALS

Aging Aircraft

Atmospheric Hazards



Atmospheric Hazards

Catastrophic Failure Prevention

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July 19, 1989, Sioux City, IA

Uncontained engine failure in a DC-10.

Engine fragments severed all hydraulic systems.

111 out of 286 on board died.

Crashworthiness

Inspection, Maintenance, And Repair

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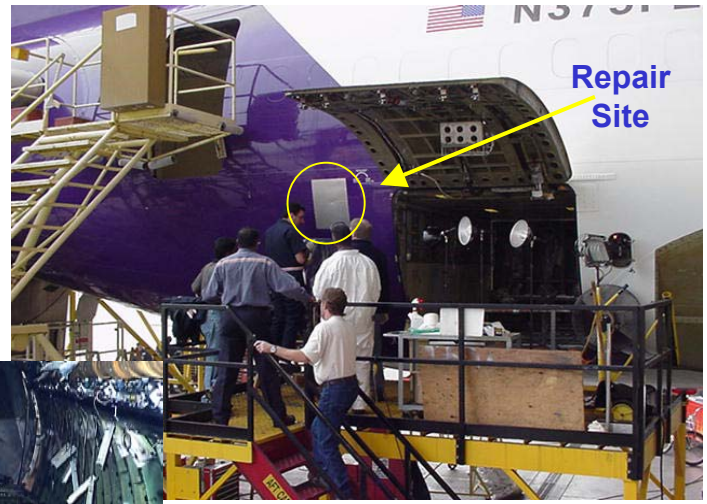
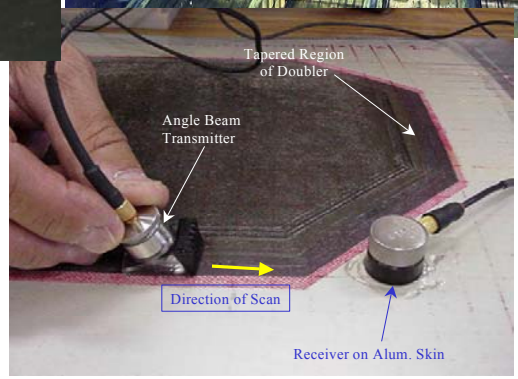
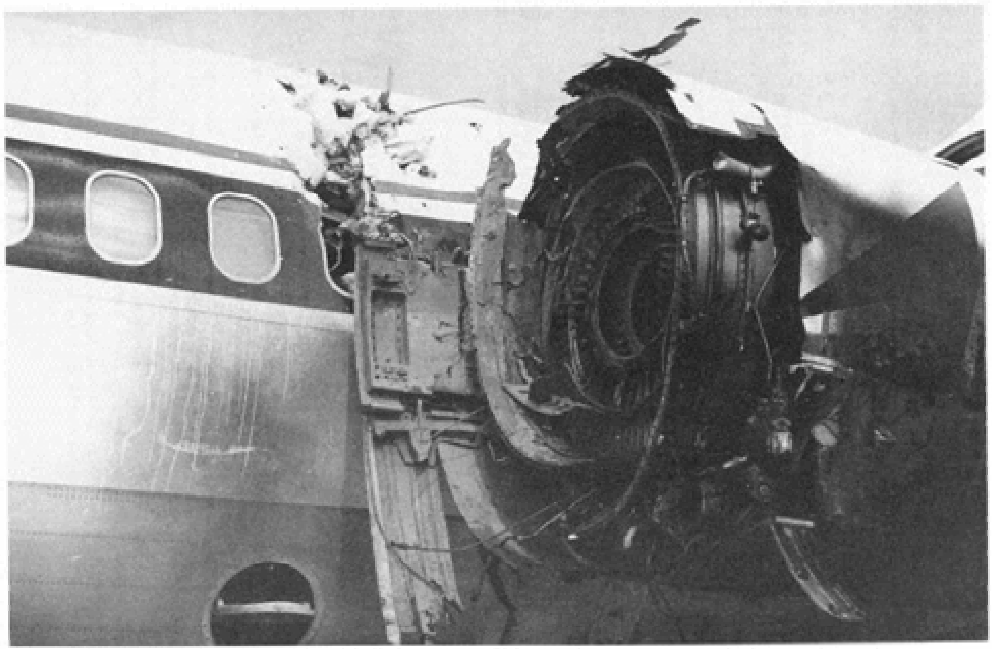




Propulsion and Fuels



Software and Digital System Display

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Structural Integrity and Flight Loads

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In flight wing failure of USDA/FS C-130 firefighting air-tanker, 6-17-02 in the Sierra Nevada range in California

Advanced Materials

BOEING'S 7E7 DREAMLINER

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AGING AIRCRAFT

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- CATASTROPHIC FAILURE PREVENTION
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- STRUCTURAL INTEGRITY AND FLIGHT LOADS

ADVANCED MATERIALS

Cold Dwell Fatigue

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- CHALLENGE
  - MINIMIZE OR ELIMINATE THE UNCERTAINTY IN DETERMINING LIFE CYCLE OF TI 6242 COMPONENTS IN JET ENGINES.
- PROBLEM
  - MICROSCOPIC FLAWS IN CRYSTAL ARRANGEMENT ARE HIDDEN DEEP IN THE STRUCTURE.

In-situ Ultrasonic Wave Monitoring of Fatigue Crack Initiation and Propagation

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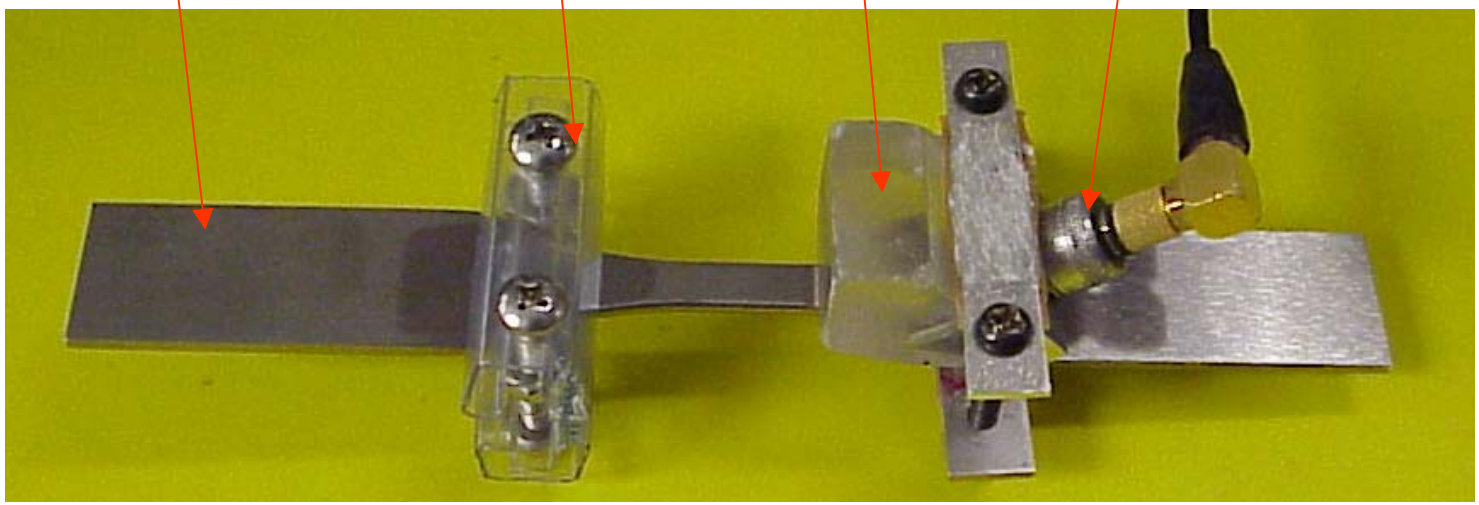
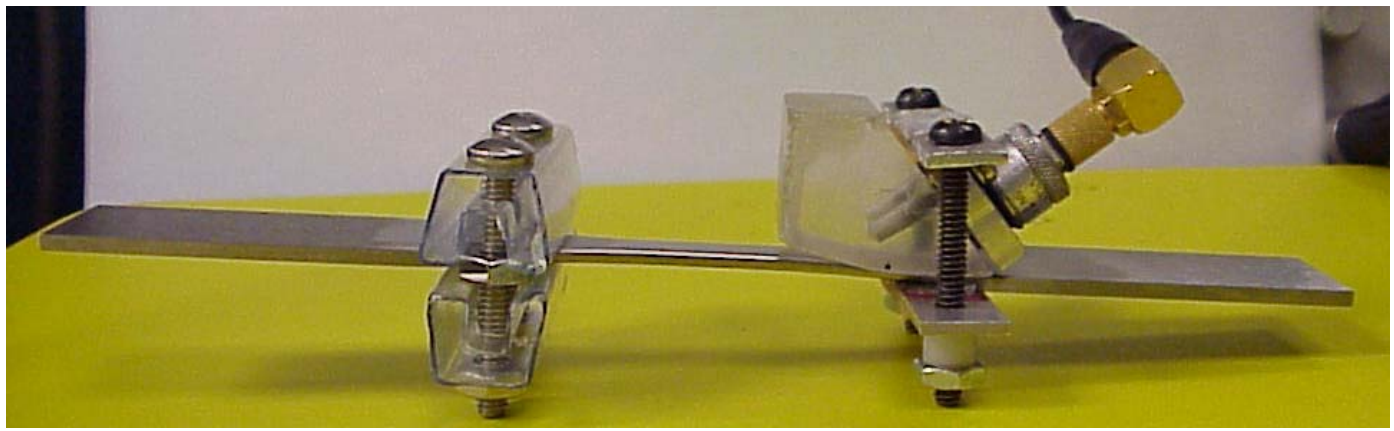
fatigue specimen reflector wedge transducer





In-situ Ultrasonic Wave Monitoring of Fatigue Crack Initiation and Propagation

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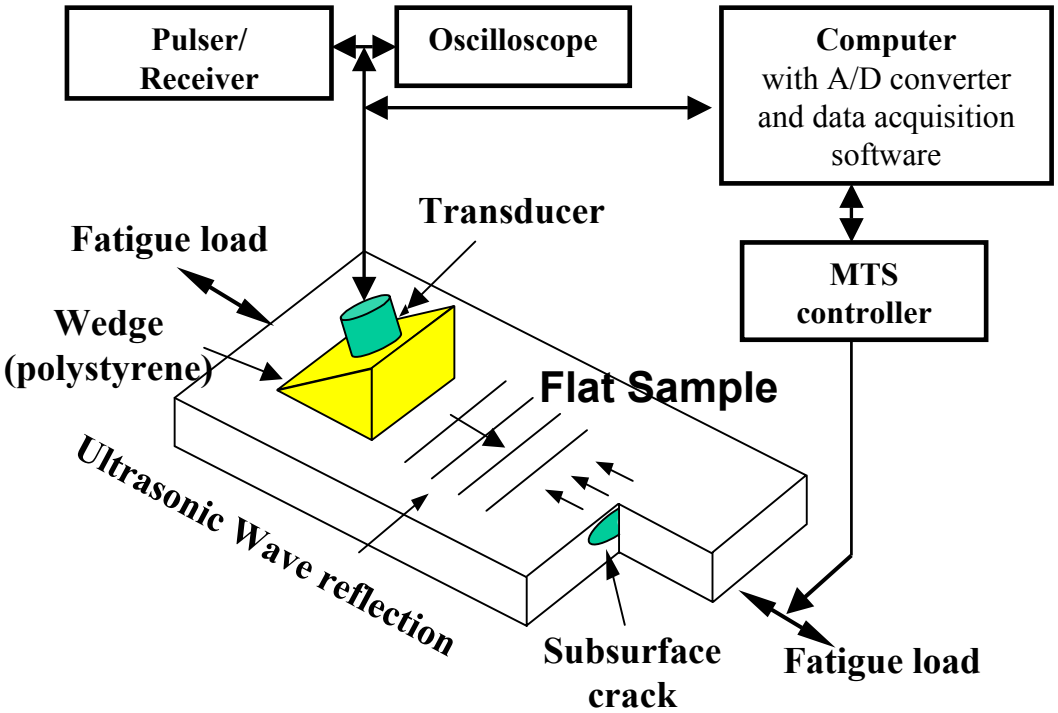

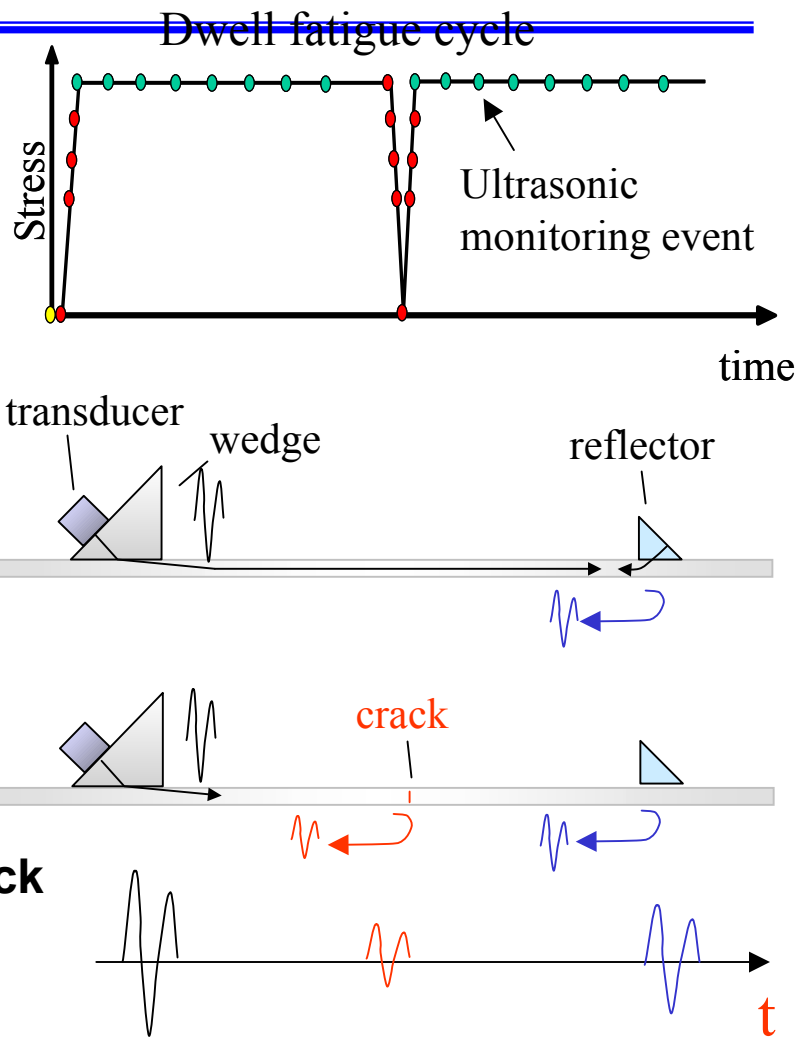

- **Ultrasonic Lamb wave reflection from the crack is measured in-situ during dwell fatigue test**
- **Single transducer with 5 MHz center frequency**

Focused Ion Beam Facility at OSU

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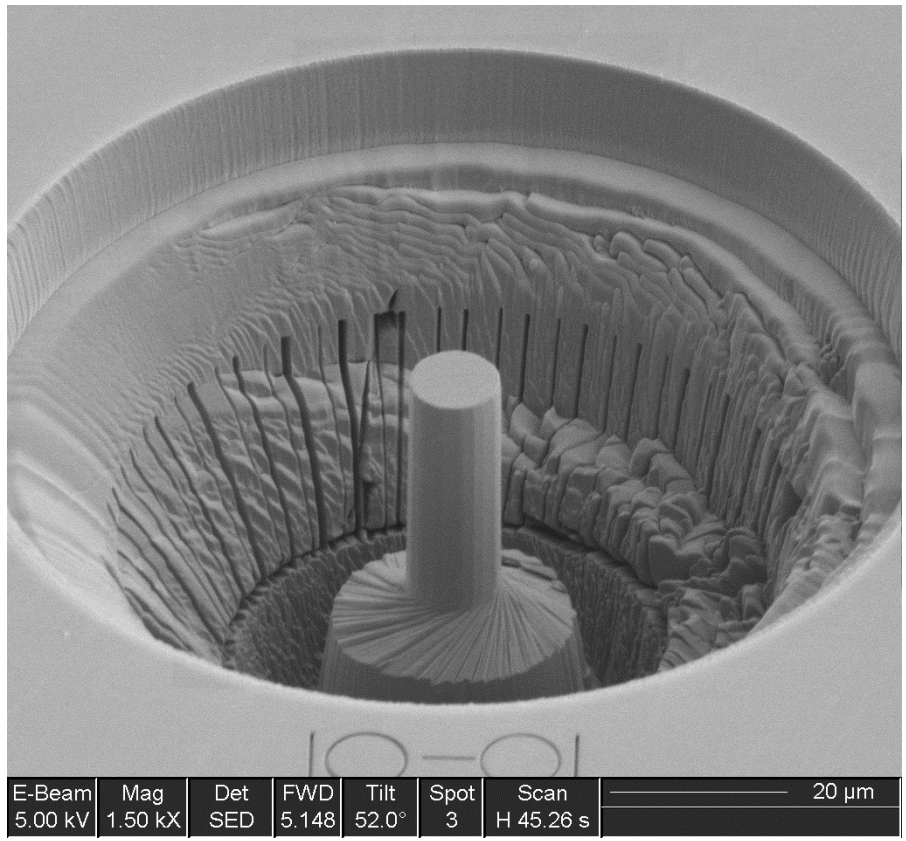
"Dual-Beam" FIB (2 at OSU):

- Ga ion column for "nano-machining"
- Electron column for imaging

- Pillars can be machined from sample surface, isolating particular microstructural features (submicron - 50 micron diameter)



Focused Ion Beam Facility at OSU

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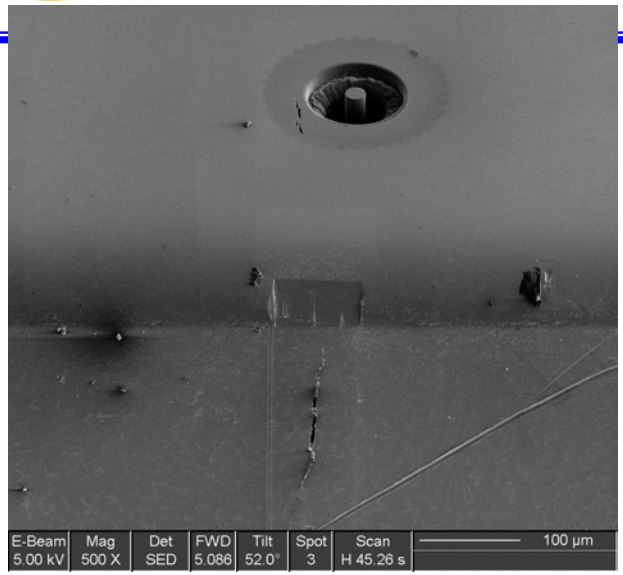
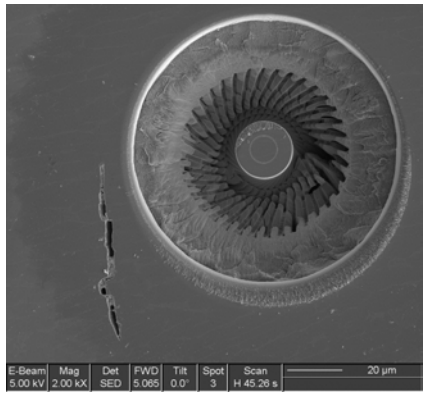
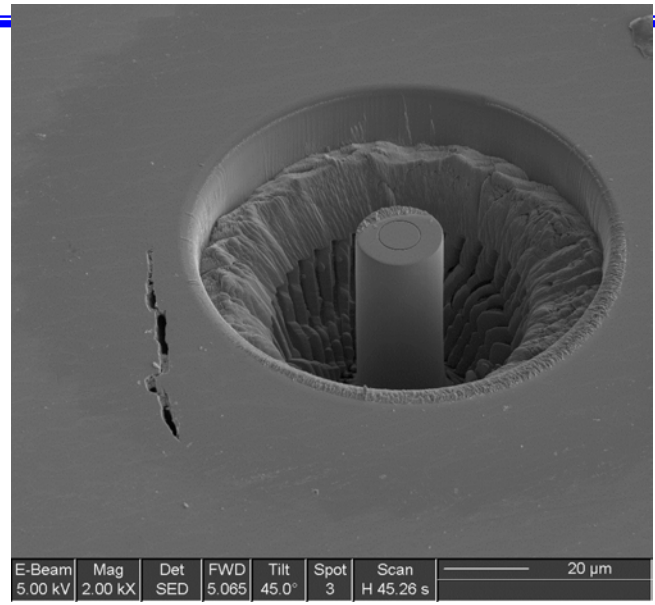
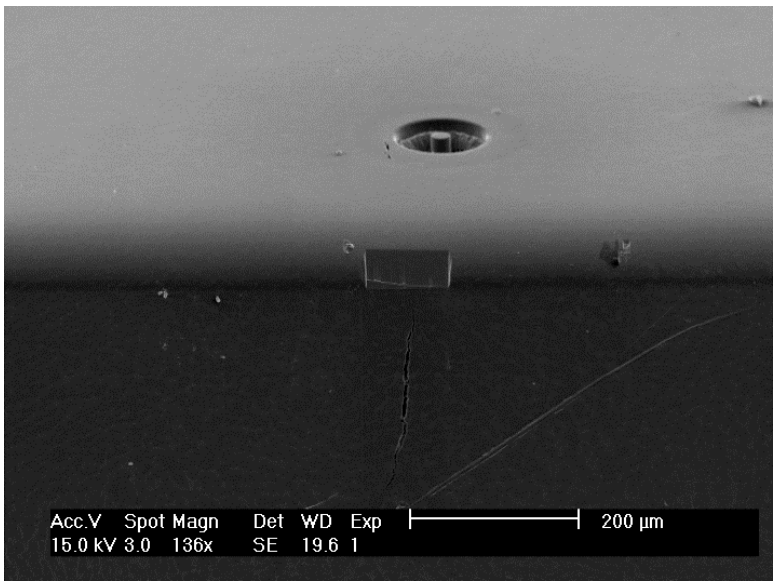
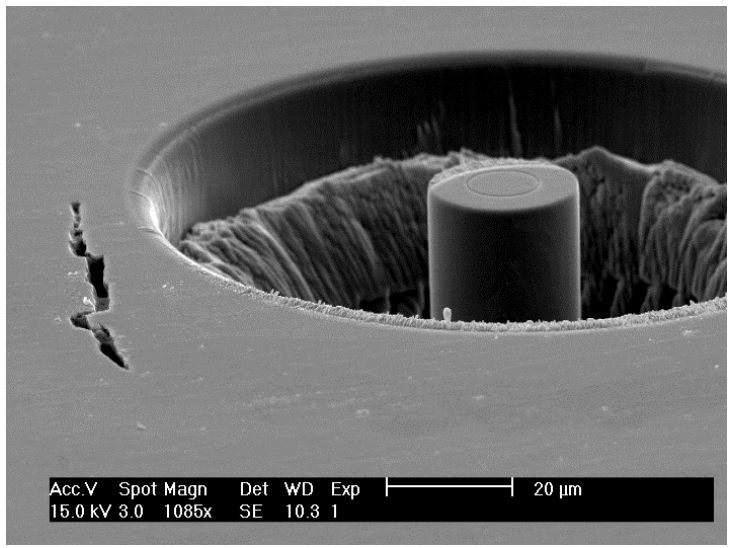


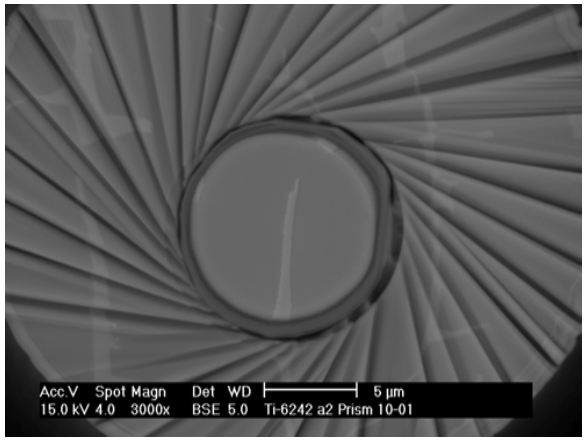


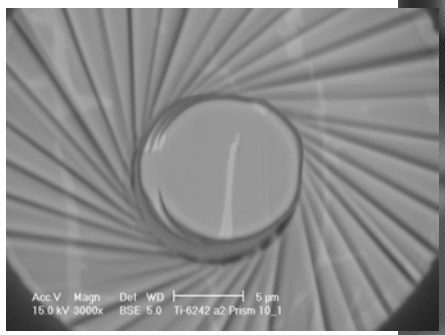


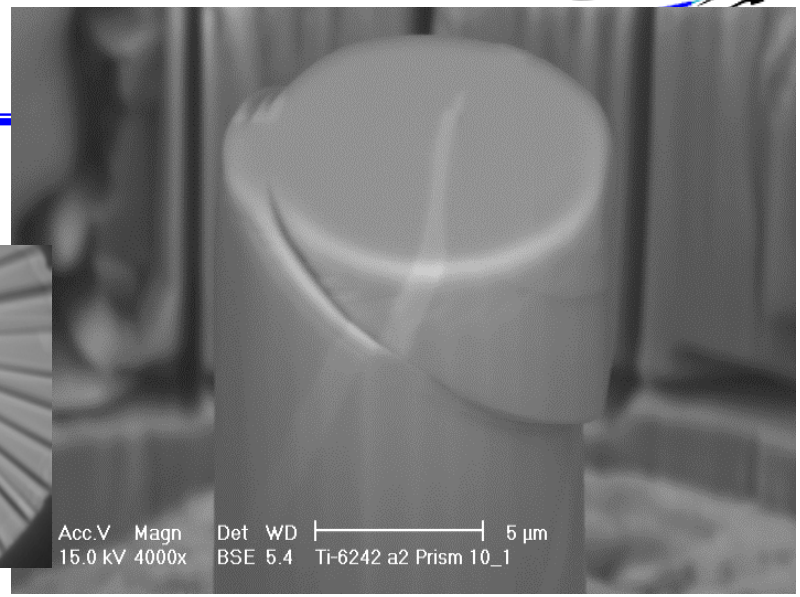


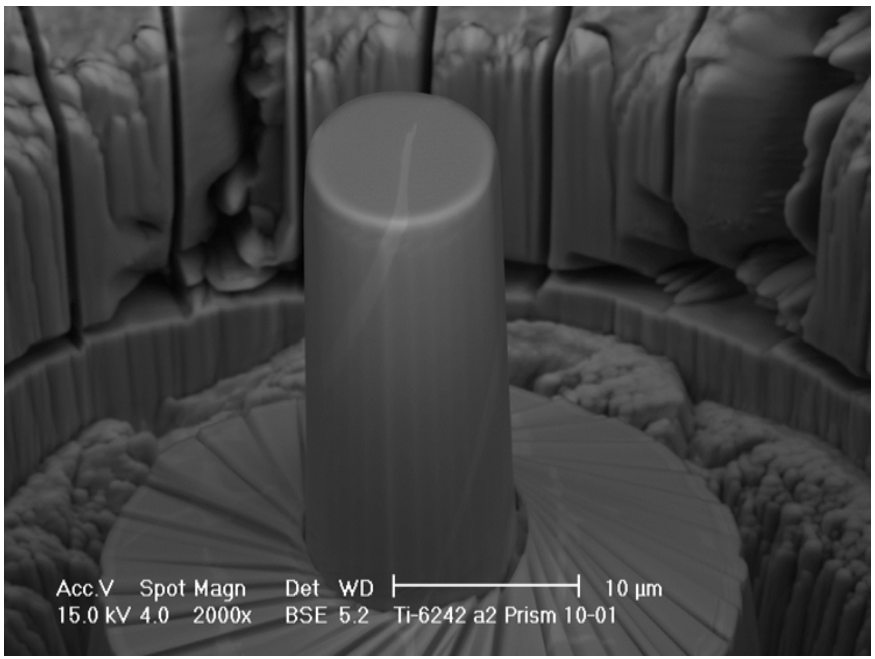


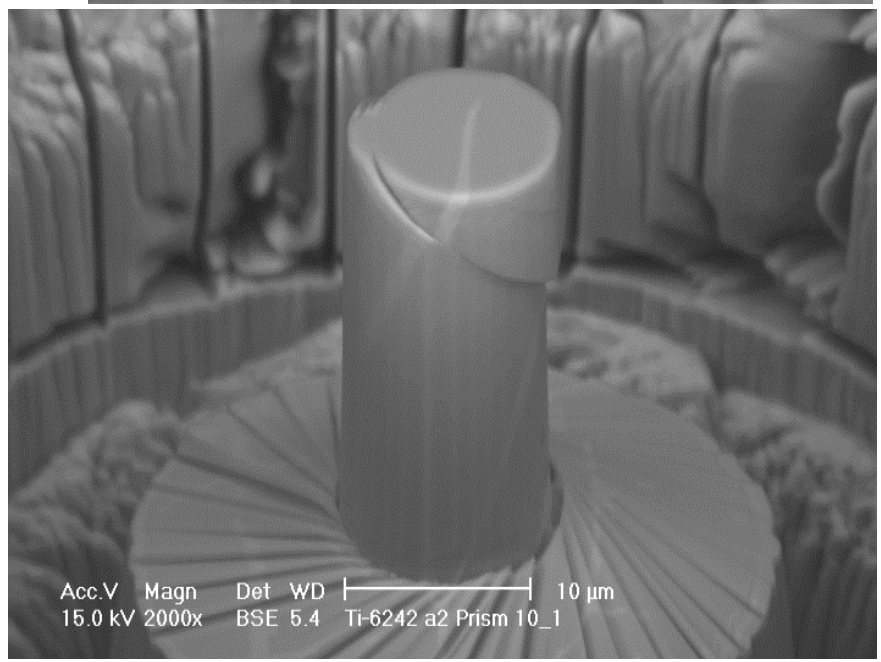
a2 Prism Micrographs



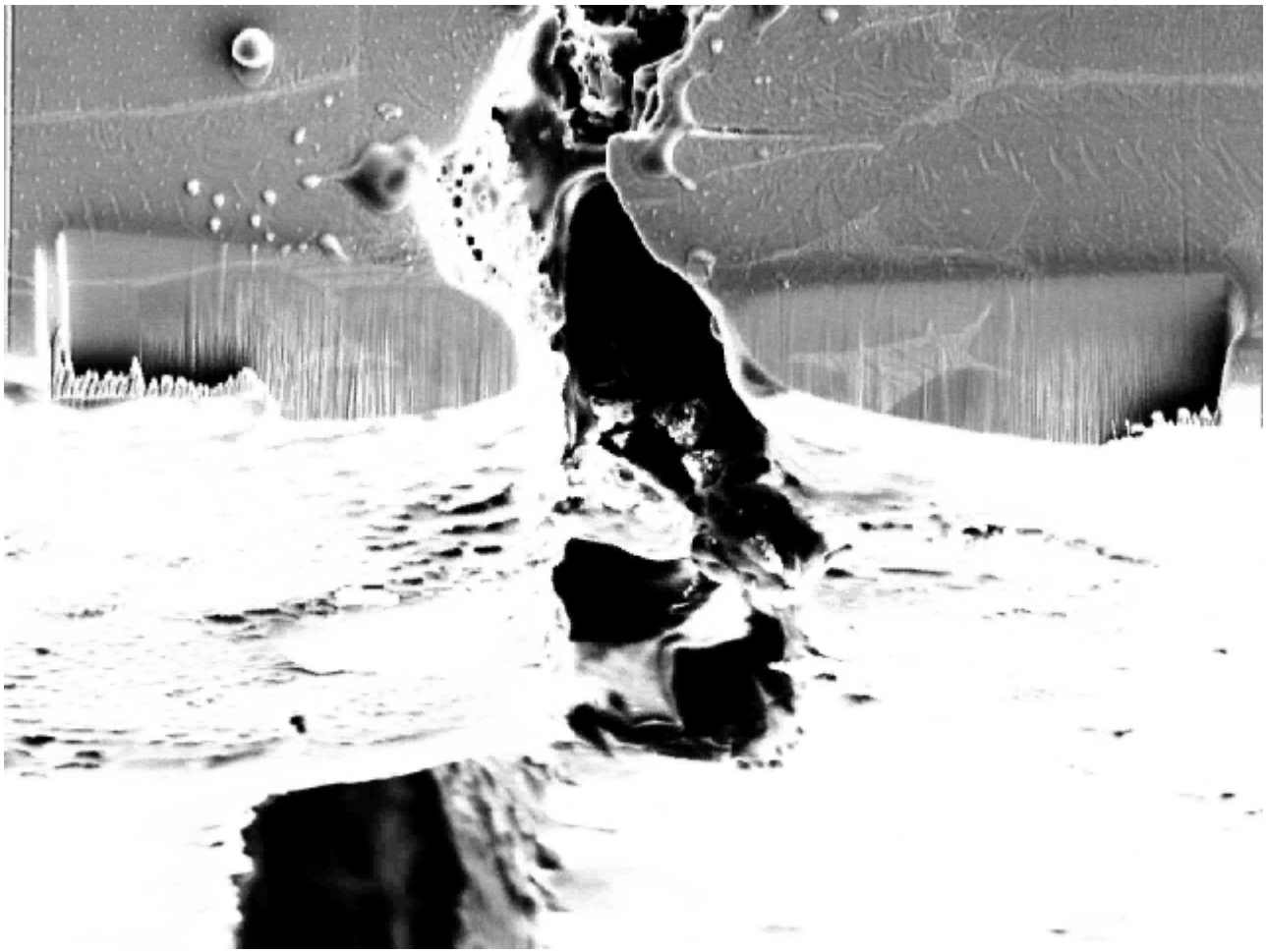








Cold Dwell Fatigue



5-Year Challenge

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"THROUGH INSIGHT OR CATASTROPHE, CHANGE WILL COME."

End of an Era

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It's a Good Life